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ABSTRACT

While the future of education will undoubtedly be intimately tied to the computer, there is still considerable doubt regarding the mode of operation and the kind of relationship which should exist. Among the implications for teacher education are these: Prospective teachers need to gain part of their own liberal arts and professional education through the new medium and need to become familiar with the available elementary and secondary level programs. Regarding the fulfillment of the dream of applying computers to the solution of educational problems, we have at present a dual failure: the awful problem of getting operational and the low quality of too many present approaches to CAI (computer assisted instruction). The great failure is at the conceptual level, most existent programs not even attempting to fulfill the basic potential that the computer offers. The need is for those working with traditional CAI programs to develop a new concept in which the material we present is not nearly as important as the learner's ability to make alternative choices, to raise intelligent questions, and to seek responses to them by calling for and applying available and pertinent data. The companies involved in developing new generations of hardware must accept responsibility for the development and use of software for educational purposes, including either agreement on a common language or provision of translators so that programs may be usable on more than one system. (JS)

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COMPUTERS IN TEACHER EDUCATION

by

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There is a real mystique about computer operations. The dazzling rapidity with which the computer spews forth its findings, the truly superhuman comprehensiveness of its capabilities and the world-shaking ramifications of its application profoundly befuddle the uninitiated, who somehow or other are made to feel that understanding how computers might assist in instruction requires a particular kind of insight, an especial intellectual brilliance, an habitual communion with esoteric engineering intricacies. Not so! What understanding CAI really requires is unmitigated optimism.

Once the educator became aware of the tremendous flexibility and comprehensiveness of the computer and its applications there has been little doubt that the future of education would be intimately tied to it. What has been in considerable doubt is the mode of operation and the kind of relationship which would exist.

When one concedes the inevitability of the use of the computer to support educational processes, the implications for teacher education need examination. This is particularly true if we expect teachers of today and tomorrow to be able to utilize this new instrument with confidence and purpose, without fear of either the instrument or of their own position. It seems reasonable to project that if we are to produce such a new generation of teachers, the computer must be intimately related to their own lives and their own education. This must happen at three different levels. First, the teacher needs to gain part of his own education through the medium of the computer. Courses exist now in several liberal arts content areas which show experimentation at this level. The course in Physics at Irvine and

and at Dartmouth, the course in Economics at Stony Brook, the course in Mathematics at Penn State, and several approaches to foreign language instruction come to mind immediately. Here is a start to solve the need of teachers-to-be to have part of their own instructional life experience in the liberal arts content attained through the medium of the computer.

Secondly, the teacher needs to have some of his own professional education, the too-often derided and under-estimated methods courses, through the medium of the computer. The future of ~~the~~ teaching a new kind of content may be dim indeed without such technological improvement.

Third, the teacher-to-be needs to become familiar with the available programs for helping children learn at the elementary and secondary school level. He needs to know these programs so that he can apply them in his own teaching. To know programs and their possibilities he should participate in developing new ones.

Experience at these three different levels needs to be provided if the next generation of teachers is not to be handicapped as the present ones are, so that they will not be fearful of this technological "monster" nor fearful of what it will do to their security. They need rather to be able to accept the tremendous challenge and opportunity for individualizing instruction which the computer for the first time enables us to reach.

How close are we to the fulfilment of this dream of applying computers to the solution of educational problems? Unfortunately, what we have at present is a dual failure: one is the awful

problem of getting operational; the second has to do with the low quality of too many present approaches to C/I.

A journey across country examining CAI installations two years ago revealed two superior programs to a person eager to get started. One a program in New Mathematics at Penn State University had been well standardized and tested in the field. The second was an inquiry-mode program developed at the University of Illinois. Of the two specialized equipment was necessary for the second, which I preferred educationally, and it was unfeasible to transfer to another institution. However the mathematics program was operating on standard IBM equipment, was written in a supposedly standard language and provided what seemed to be an ideal opportunity to become operational. Despite misgiving, I was very eager to get started; improvements could come later.

The Penn State math program was sound educationally and mathematically, had been developed on a federal grant and was therefore in the public domain.It seemed reasonable to assume that we could rent teletype machines, hook them up through data phones and telephone lines to the computer where the program was stored, schedule our students and we would be in business. Thus the primary problem would be one of raising costs of the needed hook-up rather than development of hardware or software. I later learned that this was an incredibly naive assumption that I proceeded to test out.

We have about five different computer complexes at New York University which includes most of the various generations of IBM equipment up through the model 360-50 and a huge CDC 6600 at our Mathematics Institute. Each group of people I spoke to as I went

from one to another of the Computer Centers was most cordial, encouraging, and offered to cooperate. With the availability of our own computers and personnel used to them the problem seemed a bit less frightening. However, two years later we still have not been able to get this program instituted. The problem has not been a financial one, because it would not have been too expensive. The point was never reached where the cost figures and a specific proposal could be taken to the Dean.

The blocker, as nearly as I can understand it, is one of incompatibility of interfaces, i[illegible], or should we call it "incomputability" of computer components. I thought at first to tie in to the computer where the program was stored. This was impossible; that computer was loaded and could not accept another time-sharing station. What then of storing the program in one of our computers? This was fine theoretically, but practically not feasible. The program was written in a language our computers did not comprehend. Translating programs are still unavailable. Sadly, I confess, we are still not operating.

But this is not the only problem we face when we apply CAI to Teacher Education. We find a great failure at the conceptual level as demonstrated by the comparatively few programs in existence which adequately account for the new kind of thinking about education which the computer makes possible. Most existant programs do not even attempt to fulfil the basic potential that the computer offers. We face a situation analogous to the early use of television in

which the most that could be done with the great potential of this great new medium was to show a teacher teaching a class, looking out of the video tube. Too often we merely translate the worst of current practice into new media. If the computer's application to education is to be limited to that of a glorified workbook or an automatic page-turner, it will be sad indeed. Too many existing programs are simply inadequate for the new tasks of education.

The situation in applying computers to use is closely related to the state of the art of programmed instruction as it has developed in the last decade. The research on PI for educational use was too often satisfied when no significant differences emerged between the material as programmed and its first-hand teaching by the instructor. This told us nothing about the quality of the instructor. How nearly the program came to accomplishing the objectives set up for it was important, but the quality of the objectives is simply not included in the evaluation scheme.

PI has gone through a number of different phases. There was a time back in 1961 and '62 when it appeared as if PI was the essence of the technological revolution for education. Many a school superintendent jumped on the apparent band-wagon, even if somewhat tentatively, to try out this new programmed instruction, by which it was claimed children could teach themselves as well as their teachers could teach them. Unfortunately, the willingness of the Superintendent to try the programs did not affect their quality. Too many programs of this era were stupid at worst and insipid at best. Warehouses today are still loaded with materials put together by optimistic if

somewhat careless or even ruthless publishers who seized on the band-wagon effect accompanying PI to produce a flood of materials of very doubtful quality. Superintendents of Schools who were stuck with their original enthusiasm were turned off by the quality of materials they received and the great gap between the promise and performance of PI. So much of this inferior material was produced that it not only clogged the warehouses, but effectively acted to undo all the positive attitudes about PI which had developed, so that even today despite some outstanding examples of excellent programming, the field is in the doldrums. It exists as an exciting field of work mainly for its theoretical promise rather than the fulfilment of its original dream. And it is in the dream that we find an affinity to CAI.

The dream, most simply stated, is in the area of individualization of instruction and in concretely specifying the purposes of the teaching episode. PI provides a means by which, finally, children can proceed at their own pace to learn both content and skills prescribed. PI promised that instead of the constant time of exposure by a teacher presenting material to a class, we would finally achieve variability of exposure through the medium of self-pacing by children. By providing a wide variety of available materials we would finally come to achieving self-selection of problem areas to be studied. PI theorists indicated very clearly that among the requirements for good programs was the write-test-rewrite procedure: that programs had to be tested out on live populations and modified accordingly before they were acceptable. Today, most PI people insist

that the population on which material was tried out should be identified and the results published with the material as a guide to the purchaser who could see whether or not the tested population was anything like the population he wanted to use the material with and the level of success together with the variations in that success in the tested population. Accompanying all work with PI was the important idea of establishing specific objectives which the particular program was to accomplish. These were the promises of PI. What we got over the last decade was a progression of glorified workbooks, too often untested, unimaginative and unstimulating. With the growth of CAI and the need for software, many of the PI experts moved into the vacuum. We got the same faults in programming CAI that we had in PI.

The major point to be emphasized and the basic problem has been the failure of conceptualization. Perhaps the wrong people have been developing the materials for use on the computer: on the one hand engineers; on the other PI practitioners. Perhaps we have been talking too much about instruction and not enough about education. The PI that has been most successful was that which taught definable skills, as demonstrated by the growth of PI in training programs in industry and in the armed forces. We see a similar phenomenon take place with CAI in that skill-related training has provided its most effective utilization. Perhaps this is a function of the training of the people who have developed the programs which have been utilized.

I can best illustrate my meaning further by a chat I had

[illegible] several years ago with one of the top research men in CAI of one of the big computer companies. He was telling me with some glee about a mathematics program that had been developed for adolescents in a disadvantaged school district in the East. The program provided two numerals and an operation; the responder was to provide the answer. "Nine plus six," clicked out the computer's typewriter, and the answer "fifteen," was to come from the youngster. The program was arranged so that the problem combinations were repeated more frequently than the combinations receiving correct responses. Thus the youngster had more practice in learning to respond to the combinations which gave him trouble. In this respect it was certainly individual. My question to this gentlemen was: "What is the theory of mathematics teaching on which this program is based?" He looked at me very blankly and simply did not understand the nature, the purport nor the meaning of the question.

I went after the information in another way. "Who did the program?" I asked.

"Oh!" came the response. "A couple of my boys."

"What do you mean?" I pursued. "Who were they? What was their background?"

"Oh, they're engineers," was the answer as if that solved all problems and settled all issues. This man had no idea that there was any ferment in the teaching of mathematics, that there was a revolution in the teaching of this subject in the 'thirties which had it been successful would have made the revolution of the fifties unnecessary, as Beberman pointed out. These changes placed great emphasis on teaching understanding of meanings rather than mere

mechanical response in teaching arithmetic. Here we had the anomoly of this most fantastic representation of twentieth century mastery of technology, in its latest version representing fourth generation computers being utilized to provide an antediluvian, out-moded, discredited approach to the teaching of mathematics. This research person's gleeful "It worked!" fell very dully on my ears for his criteria for what working means were very different from that applied in current teaching of mathematics.

Another illustration, this one from the field of Programmed Instruction, may be helpful. At my request a course was set up in our division entitled "Programmed Instruction in Childhood Education." One of the outstanding people in the country in this field was instructor. I asked about changing it to "Programmed Learning in Childhood Education" on the basis that instruction is what the teacher does but learning is what the child does. Back of my question of course was the whole concept of how can we set up our materials so as to insure the child's learning not merely our instruction of the child. He laughed and understood exactly what I meant but indicated that the state of the art was not such as to insure that outcome. We retained the title.

It is time for us to rethink that popular title--Computer Assisted Instruction-- and begin to reconceptualize this instrument from its primary use by the teacher to its primary use by the learner. This may lead to Computer Assisted Education. Let us pursue this idea.

In an instructional program the learner is told what to do, what he should know, when he should know it, and perhaps how he may use what he has learned. His success is measured on his ability to

regurgitate the proper answers to the proper questions, which parallel the material which has been presented. Education, however, goes far beyond this and presumes that the learner cannot only acquire the knowledge needed but can apply it in new and different situations. Material which is primarily factual can probably be adequately presented in an instructional mode. When it comes to the application of information, the use of those facts in new and different situations we need to develop brand new approaches. This is precisely what has gone wrong with CAI. If it is the facts that we are interested in communicating we have to live with the notion that these facts change, and not only is that change rapid, but at an accelerating rate. The important contribution of the computer will not be, I venture to forecast, to teach those facts on a massive scale, nor to provide storage for programs which have this factual imparting as their primary purpose. Such programs can just as readily be mounted in other kinds of hardware, if they need hardware at all. Let us not forget that the computer itself can store the facts, keep them current, and reveal them in a retrieval system as needed. The user no longer needs to retain them for himself. The uniqueness of the computer, its speed, its flexibility, the vastness of its storage of materials, the quality of the responses it can provide, need to be placed at the disposal of the learner as he solves problems which are real to him.

I have a few questions about the development of CAI over these past few years, questions about some matters which block its use effectively in teacher education. Why is it that the only program I found in an inquiry mode, that is, other than a linear or branching instructional program, was one worked out by Bitzer and Suchman at

the University of Illinois? Nothing further seems to have been done with the Inquiry Mode. Why?

What has happened to the early efforts to give the computer a voice so that reading skill would not be a primary factor in determining the success of the student?

What came of the notion of giving the computer tremendous resources as an educational data bank?

What became of the potential of using the computer as a controlling mechanism as part of a larger program for numerous different audio-visual devices? In the earlier stages of its development the computer was used to control a series of slides, tape recorders, video recorders, cartridge-type film loops, and it was used as an information retrieval instrument. All of these have tremendous potential educationally. Why have they not been more adequately explored?

We are all using microfiche these days. Have you seen the latest "ultra-fiche" produced by National Cash Register, in which some 3,000 pages of material are reproduced on a fiche of the standard four- by six-inch size that we have been using for 64 to 90 pages? The coordinates which would locate any one of these pages are simple x,y coordinates. Ten volumes of material could be adequately reproduced on a single fiche and access to any of these pages controlled by simple location of x,y coordinates. The computer-controlled reproduction of any of these pages in any desired sequence on a read-out screen or print-out is within the scope of the art today. Is anybody working with it?

What happened to simulation as a primary learning device? The computer offers storage and retrieval possibilities that are breath-taking. No one seems to care.

And when will the big companies do something about insuring the compatibility of program languages? Remember the time of competition between various systems of color television? Remember the early chaos about varying tape recorder speeds, the shift from wire to tape, and how standardization clarified that situation? You are all familiar with the corresponding confusion about current video tape recording differences in speeds and widths of tape. But there comes a time when the futile notion that each manufacturer holds that his own process is so superior that everyone will adopt it must give way to the notion that the primary good of the consumer is served by compatibility and the ultimate profit of the manufacturers lie in the direction of providing such compatibility.

In the interest of applying computer potential further to the field of teacher education, let me close with a charge. To those who are working with traditional programs in CAI, to develop a new concept of CAE, in which the material we present is not nearly as important as the learner's ability to make alternative choices, raise intelligent questions, seek responses to them by calling for and applying available and pertinent data. Let us charge the companies involved in developing new generations of hardware to accept responsibility for the development and use of software for educational purposes; part of this responsibility is to either agree on a common language or provide translators so that programs may be usable on more than one system.